



CSIR NEXTGEN HEALTH

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science & innovation

Department:
Science and Innovation
REPUBLIC OF SOUTH AFRICA



CSIR

Touching lives through innovation

ABOUT THE CSIR

The Council for Scientific and Industrial Research (CSIR) is a leading scientific and technology research organisation that researches and develops transformative technologies to accelerate socioeconomic prosperity in South Africa.

The organisation's work contributes to industrial development and supports a capable state. The CSIR is an entity of the Department of Science and Innovation.

The organisation plays a key role in supporting the public and private sectors through directed research that is aligned with the country's priorities, the organisation's mandate and its science, engineering and technology competences.

The nine high-impact sectors identified by the CSIR to achieve its aims are:

Industry advancement clusters



Advanced Agriculture and Food



NextGen Health



Future Production: Chemicals



Future Production: Mining



Future Production: Manufacturing



Defence and Security

Industry and society enabling clusters



Smart Places



Smart Mobility



NextGen Enterprises and Institutions



ABOUT CSIR NEXTGEN HEALTH

CSIR NextGen Health centres on a One Health approach to achieve optimal health outcomes, with a focus that spans the full health value chain – from prevention to diagnosis, treatment and monitoring – while supporting the health sector with capabilities to utilise fourth industrial revolution technologies.

South Africa's growing burden of disease calls for the health sector to provide accessible and cost-effective health technologies and medicines for impactful health service outcomes.

The CSIR's key strategic interventions and investments in support of South Africa and Africa's health systems are driven from two groups:

- Medical devices, diagnostics and vaccines impact area
- Synthetic biology and precision medicine research centre

ABOUT CSIR NEXTGEN HEALTH *continued*

▶ MEDICAL DEVICES, DIAGNOSTICS AND VACCINES IMPACT AREA

Two research groups drive research, development and innovation on medical devices, diagnostics and vaccines.

- The **veterinary vaccines and diagnostic group** focuses on vaccine research using bacteria and plant-based expression systems, as well as developing point-of-care molecular diagnostic kits (including lab-on-chip and point-of-care solutions) for veterinary, aquaculture and zoonotic diseases.
- The **human molecular diagnostics and omics group**, which focuses on developing a thriving local medical device and diagnostic industry, through the use of in-house microsphere technology for novel workflows and sample preparation and point-of-care diagnostic assay development for infectious diseases, as well as proteomics for clinical research, including proteomics data science with tailored data interpretation for drug discovery, identification of biomarkers and new-age diagnostics.

▶ SYNTHETIC BIOLOGY AND PRECISION MEDICINE RESEARCH CENTRE

Three research groups advance technologies and innovations in this field.

- The **industrial synthetic biology and nanobiomachines group** features key platforms for research on synthetic biology and cancer precision medicine.
- The **bioengineering and integrated genomics group** focuses on African microbiome research, digital precision medicine, adverse drug reaction, genome engineering and stem cell bioengineering to improve the disease treatment outcomes of African populations.
- The **companion diagnostics and array printing group** uses array technologies for high-throughput screening to apply in drug screening, malaria drug discovery and point-of-care diagnostics as well as multiplex point-of-care diagnostics tests.



FIVE STRATEGIC CAPABILITY PLATFORMS TO SUPPORT SA'S HEALTH SECTOR

The Covid-19 pandemic highlighted the need for South Africa to be better prepared for future pandemics through investment in health research and development, the capability to produce vaccines at large scale and investment in smart health solutions.

The CSIR aims to support the state in achieving its key priorities in health in the following areas: health systems and digitisation, localisation of medical devices, diagnostics product innovation, vaccine development and lastly, the development of precision medicine tools to support efforts to improve healthcare outcomes.

This is done through the following five strategic capability platforms:

- Health systems and digital health platform;
- Medical devices and diagnostics platform;
- Vaccines platform
- Precision medicine platform; and
- Array technology platform

➤ THE HEALTH SYSTEMS AND DIGITAL HEALTH PLATFORM

The health systems platform focuses on interoperable health information systems for continuity of care and patient-centric healthcare delivery.

The CSIR's strategic response ensures an appropriate and up-to-date standards framework for eHealth systems, provides technical guidance for implementation of standards, and national shared information, as well as communications technology infrastructure for health data exchange.

Furthermore, the CSIR focuses on the digitisation of health information, as well as big data and data mining, in profiling the South African population and its predisposition to certain diseases – work that requires extensive collaboration.

All these tools will be particularly important in the rollout of the proposed National Health Insurance (NHI).

The ability of the CSIR to localise and adapt digital platforms to local content is a key value proposition to national government. This will continue to be a priority for the CSIR when the NHI is rolled out.

FIVE STRATEGIC CAPABILITY PLATFORMS TO SUPPORT SA'S HEALTH SECTOR *continued*

➤ THE MEDICAL DEVICES AND DIAGNOSTICS PLATFORM

This platform focuses on developing a thriving local medical devices and diagnostic industry and positions South Africa as an exporter of these technologies.

The CSIR develops mobile healthcare coordination and new payment systems, as well as synergistic molecular and integrated diagnostics that are designed to meet the need of developing world end-users for such diagnostics that affordable, sensitive, specific, user-friendly, rapid, equipment-free and deliverable (ASSURED).

While major hospital groups offer advanced in-house medical technologies, these are expensive in the context of the socio-economic challenges faced by the majority of South Africans. Point-of-care devices and diagnostics are an approach that must be considered as they contribute towards:

- cost containment through shorter time spent in emergency rooms and other critical care environments;
- easing the burden of health workers, who are in short supply; and
- providing better patient care by improving the turn-around-time that point-of-care testing offers.

In addition, increasingly, only moderate technical skills are required to perform point-of-care tests.

Connectivity has become a major concern, as more data is generated from point-of-care testing instruments and devices. Data management systems that organise and integrate test results and make them available to physicians and medical records personnel, need to be offered by device vendors.

Animal health

Animal health is another area of focus of this platform due to its indirect impact on human health. The veterinary sector, over

the years, has received cash injections for early detection and monitoring tools from philanthropic organisation in support of governments as well as industry associations. This has been influenced by:

- Increased demand for meat and other livestock products, especially in Africa, and associated need for disease control by developing vaccines as preventative measures for both indigenous and possible trans-boundary diseases;
- Increased human, animal and food transport, with climatic change and increased productivity driving growth. Approximately 60% of emerging diseases are zoonotic in nature and arise in animals. Controlling pathogens is vital in the context of livestock consumption; and
- Increased demand for diagnostics for veterinary and zoonotic diseases at point of care.

➤ THE VACCINES PLATFORM

The vision for the platform is to build local capabilities for the development of next-gen greenpharm vaccines for Africa.

The focus is on:

- Developing the next generation of plant-produced vaccine candidates for veterinary and human health; and
- Producing plant-expressed biologicals (antibodies, antigens, peptides) for use in diagnostics and vaccine development.

There is a growing demand for the development and production of cost-effective biopharmaceuticals suitable for the local South African and African market. The platform utilises recombinant technologies for protein production, including vaccines, antigens, antibodies and peptides serving the veterinary and human health space for diagnostics and vaccines.

Cost-effective production is key to affordable healthcare in South Africa and rest of Africa.

The platform delivers impact through:

- Contributing towards local vaccine innovation capabilities; and
- Developing a pipeline of next-generation vaccines for diseases burdening the African continent.

This will enable the continent to be self-sufficient in its response to disease outbreaks and less reliant on imported products.

> THE PRECISION MEDICINE PLATFORM

Using this platform, the CSIR develops innovative technology solutions and African-specific screening assays to reduce development time, save investment cost and lower barriers to market entry of active pharmaceutical ingredients.

The platform focuses on precision medicine, companion diagnostics, proteomics and stem-cell technologies to discover protein-biomarker treatments, predict adverse drug reactions, develop novel models of disease and investigate nano-technology for targeted drug delivery and precision treatments.

Why African-specific screening essays?

The landscape of modern healthcare is changing rapidly as diagnostic tools are becoming available in the market. However, in emerging and developing countries like South Africa, lack of accessibility to health technologies that allow for informed prediction of how individuals respond to specific treatments, along with a poor understanding of unique biological and environmental factors causing disease, prohibit an efficient and effective healthcare system. Currently, pharmaceutical compounds are developed in Western Europe and the United States of America on a largely Caucasian population, thus representing very narrow genotypic diversity.

In the absence of tools to screen drugs against gene diversity, two possible problems could be experienced by the patients, namely: severe adverse drug reactions, or, the drugs do not work from the outset.

The establishment of the precision medicine platform is an expression of the importance of having drugs screened against Africa's diverse genes and microbiome profiles. This has created opportunities for public/private partnerships to support the localisation of these tools, and bringing them to the African market.

> ARRAY TECHNOLOGY PLATFORM

The goal of this platform is two-fold: first, it seeks to employ microarray technology to develop high-throughput screening technologies for more rapid and cheaper screening of libraries of small molecules for compounds with potential for use against various diseases ranging from HIV/AIDS, tuberculosis, Covid-19 and malaria to different cancers. The ultimate purpose here is to reduce the cost of screening for novel drug candidates, thus resulting in overall drug cost reduction.

Secondly, the platform aims to employ microarray technology to develop novel multiplex and point-of-care diagnostic tools for quicker and cheaper diagnosis of diseases that are affecting South Africa's population, especially those living in rural and remote areas. This means that they can be moved to treatment quicker than it would normally be the case.

Between 40% and 60% of the South African and African populations, respectively, live in rural areas, with limited access to laboratory infrastructure, and therefore the potential for impact of the point-of-care diagnostic tools developed by the CSIR, is significant.

OUR INFRASTRUCTURE AND TESTING CAPABILITIES



▶ SERVICE OFFERINGS:

Testing services

The CSIR provides testing services where extracts and drug candidates from external clients (often biotech companies) are tested for activities and toxicities in-vitro before they are moved down the value chain into animals and human trials.

In addition, the platform tests disinfectants (chemical solutions and umbilical venous catheter-based devices) for activities against viruses and bacteria.

Through this work, many small, medium and micro enterprises and larger enterprises in the country have been supported with product (disinfectants) development and registration.

Covid-19 testing facility

The CSIR offers Covid-19 testing at its campus in Pretoria, having repurposed its existing state-of-the-art biosafety level 3 (BSL3) laboratories to help ramp up government's efforts to expand testing in the context of the Covid-19 pandemic.

The facility is certified as a BSL3 diagnostic laboratory in line with the approved international standards for Covid-19 testing.

The CSIR uses state-of-the-art KingFisher Automated Nucleic Acid Extraction machines and a QuantStudio 5 Real-Time polymerase chain reaction (PCR) machine.

Trained and highly skilled scientists have expertise in molecular diagnostics, real-time PCR and nucleic acid extraction.

Synthetic nanobiotechnology and biomachines

The focus of the CSIR's synthetic nanobiotechnology and biomachines area is to generate superior cell lines for improved biopharmaceutical production. This is done through utilising the full body of knowledge generated to date on cells and to evolve this to develop a cell line more fit for purpose, in terms of both cost and production capacity. Such cell line will offer significant advantages with respect to biotherapeutics production.

The synthetic nanobiotechnology and biomachines group also works on drug repurposing for cancer precision medicine. The team is working on a proof of concept to showcase that individually designed high-throughput drug sensitivity screening can be more cost-effective for cancer patients.

Proven, diverse research skills and expertise

State-of-the-art infrastructure, underpinned by strong capabilities and expertise in the defined strategic areas, provides a baseline for this group to conduct high-impact research for early detection of diseases, better treatment outcomes and to drive a robust healthcare industry in South Africa.

The CSIR has proven and diverse skills and expertise in the health research sector, from molecular diagnostics and natural product chemistry to bioengineering and integrated genomics.

Key partners that support CSIR NextGen Health include the Department of Science and Innovation, the Technology Innovation Agency, the Development Bank of Southern Africa, as well as other partners in the public and private sectors, locally and internationally.

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